# TED07 – (Part E12) Further Water and Soil for HL

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. E.12.1 Solve problems relating to the removal of heavy-metal ions, phosphates and nitrates from water by chemical precipitation. (3)

*Given the equilibrium formed by a metal M and a non-metal X: MX(s)⇌M+(aq) X-(aq).*

*The Keq for this system is given by Ksp = [M+][X−], and is called the solubility product constant.*

*Students should be able to solve problems associated with this type of equilibrium, including the common ion effect.*

* 1. How does the addition of another compound effect the solubility in water?
  2. How does temperature effect the solubility of a solid or gas in solution?
  3. For a partially soluble salt, the following equilibrium is used () provide the equilibrium expression, Kc:
  4. Now rearrange to solve for Ksp, the solubility constant:
  5. For a complex metal such as Al(OH)3 provide the Ksp:
  6. Calculating Ksp from solubility:
     1. Solubility of lead (II) bromide at 298K is 6.15
  7. Calculating solubility from Ksp
     1. Ksp [Al(OH)3] = 1.0x10-32
  8. What is the common ion effect?
  9. Calculate the common ion effect when AgCl is dissolved in a solution of NaCl:
     1. First, determine the molarity of AgCl dissolved in water: (for AlCl Ksp=2.0x10-10 at 298K, dissolved in H2O)
     2. Now, if the same salt is dissolved in NaCl(s) ⇌ Na+(aq) + Cl-(aq) (solution is 0.1M) find the molarity of AgCl in the solution:

1. E.12.2 State what is meant by the term cation-exchange capacity (CEC) and outline its importance. (2)

*The amount of exchangeable cations in a clay is called cation-exchange capacity. Include equations as appropriate.*

* 1. What is the cation exchange capacity (CEC)?

1. E.12.3 Discuss the effects of soil pH on cation-exchange capacity and availability of nutrients. (3)

*Examples of nutrients include Ca, Mg, Fe, Al, P, N, S, Cu and Zn. Use equations as appropriate.*

* 1. What happens to the solubility of cations when acids are added to soils?
     1. Provide an equation using Mg2+ as your example:
  2. What happens to the solubility of anions when acids are added to soils?
     1. Provide an equation using OH- and HNO3:

1. E.12.4 Describe the chemical functions of soil organic matter (SOM). (2) *Include the following:*

*Contributes to cation-exchange capacity*

*Enhances the ability of soil to buffer changes in pH*

*Binds to organic and inorganic compounds in soil*

*Reduces the negative environmental effects of pesticides, heavy metals and other pollutants by binding contaminants*

*Forms stable complexes with cations*